1. A system for producing a foamed material comprising

extrusion means

means connected to said extrusion means for supplying a material to be foamed to said extrusion means;

die means for shaping material;

said extrusion means connected to said die means for providing extruded material to said die means;

means for heating said extrusion means to cause said extrusion means to provide said extruded material at a higher temperature than room temperature to permit said die means to produce shaped continuous heated material;

means for engaging and transporting said shaped continuous heated material through an enclosed volume;

means connected to said enclosed volume for supplying supercritical fluid to said enclosed volume to introduce said supercritical fluid into said shaped continuous heated material at a higher pressure than atmospheric pressure;

means for retaining said shaped continuous heated material within said enclosed volume for a suffi-

cient time period to permit said supercritical fluid to saturate said shaped continuous heated material;

means for removing said shaped continuous heated material saturated with said supercritical fluid from said enclosed volume at a pressure which is less than said higher pressure; and

foam heating means for heating said material which has been removed from said enclosed volume so as to produce shaped continuous heated foamed material having a plurality of cells distributed substantially throughout said foamed material.

2. A system in accordance with claim 1 wherein said die means is a sheet die means for providing a continuous sheet of heated material.

3. A system in accordance with claim 2 wherein;

said engaging and transporting means includes a plurality of rollers maintained at a substantially constant temperature for transporting said continuous sheet of heated material through said enclosed volume; and

said retaining means including means for controlling the position of at least one of said rollers so as to control the residence time of said continuous sheet of heated material as it is transported through said enclosed volume.

4. A system in accordance with claim 2 wherein said removing means includes a dynamic pressure seal through which said heated sheet material is removed from said enclosed volume and further including chilled roller means engaging and transporting said removed heated sheet material from said enclosed volume at a temperature below said higher temperature.

5. A system in accordance with claim 2 wherein said foam heating means includes at least one heater and heater transporting means engaging said removed sheet material for transporting said removed sheet material along a path adjacent said heaters.

6. A system in accordance with claim 5 wherein said heater transporting means includes:

at least one roller; and

means for controlling the position of at least one of said rollers to control the time over which said sheet is transported along said path adjacent said heaters.

7. A system in accordance with claim 2 and further including means for further engaging said removed continuous sheet of heated foamed material for annealing said continuous sheet of heated foamed material.

8. A system for providing a foamed material comprising

extrusion means;

die means connected to said extrusion means for shaping material;

means connected to said extrusion means for supplying a material to be foamed to said extrusion means;

means for heating said extrusion means to place said material into a molten state during the extrusion thereof in said extrusion means;

means connected to said extrusion means for supplying a supercritical fluid at a higher pressure than atmospheric pressure to said extrusion means to introduce said supercritical fluid into said molten material so that said material is saturated with said supercritical fluid to form a solution, said supercritical fluid saturated material being supplied from said extrusion means to said die means to produce a shaped continuous material saturated with said supercritical fluid;

means for engaging and transporting said shaped continuous material through an enclosed volume having a pressure which is lower than said higher pressure so as to produce cell nucleation in said shaped continuous material and means for maintaining the temperature of said shaped continuous material at a selected temperature as said material is transported through said enclosed volume at said lower pressure; and

foam heating means comprising heaters for heating said shaped continuous material as it exits said enclosed volume so as to produce a shaped continuous foamed material having a plurality of cells distributed substantially throughout said shaped continuous foamed material.

9. A system in accordance with claim **8** wherein said die means is a sheet die means for providing a continuous sheet of material.

10. A system in accordance with claim **9** wherein said transporting and temperature maintaining means includes a plurality of chilled rollers.

11. A system in accordance with claim **10** wherein said engaging and transporting means further includes means for controlling the position of at least one of said rollers so as to control the residence time of said continuous sheet of material as it is transported through said enclosed volume.

12. A system in accordance with claim **9** wherein said foam heating means includes:

at least one roller engaging and transporting said continuous sheet of material exiting said enclosed volume along a path adjacent said heaters; and

means for controlling the position of at least one of said one or more rollers to control the time over which the continuous sheet of material is transported along said path adjacent said heaters.

13. A system in accordance with claim **9** and further including means further engaging said continuous sheet of foamed material for annealing said continuous sheet of foamed material.

14. A system for producing a foamed material comprising

extrusion means;

die means connected to said extrusion means for shaping material;

means for supplying a material to be foamed to said extrusion means;

means for heating said extrusion means to place said material in a molten state during extrusion thereof in said extrusion means;

means connected to said extrusion means for supplying a supercritical fluid at a higher pressure than atmospheric pressure to said extrusion means to introduce said supercritical fluid into said molten material so that said molten material is effectively saturated with said supercritical fluid, said material which is saturated with said supercritical fluid being supplied from said extrusion means to said die means to produce a shaped continuous material;

means for engaging and transporting said shaped continuous material through an enclosed volume having a pressure which is substantially the same as said higher pressure and means for maintaining the temperature of said shaped continuous material at a selected temperature as said shaped continuous material is transported through said enclosed volume at said higher pressure; and

means for reducing the pressure and the temperature of said shaped continuous material as it exits from said enclosed volume so as to produce a shaped continuous foamed material having a plurality of cells distributed substantially throughout said shaped continuous foamed material.

15. A system in accordance with claim 14 wherein said die means is a sheet die means for providing a continuous sheet of material.

16. A system in accordance with claim 15 wherein said transporting and temperature maintaining means includes a plurality of rollers.

17. A system in accordance with claim 16 wherein said engaging and transporting means further include means for controlling the position of at least one of said rollers to control the residence time of said continuous sheet of material as it is transported through said enclosed volume.

18. A system in accordance with claim 15 and further including at least one chilled roller positioned near the exit of said enclosed volume through which said continuous sheet of foamed material passes so as to maintain the foamed condition thereof.

19. A system in accordance with claim 15 and further including means further engaging said continuous sheet of foamed material for annealing said continuous sheet of foamed material.

20. A system for producing a foamed material comprising

extrusion means;

die means connected to said extrusion means for shaping material;

means for supplying a material to be foamed to said extrusion means;

means for heating said extrusion means to place said material in a molten state during extrusion thereof in said extrusion means;

means connected to said extrusion means for supplying a supercritical fluid at a higher pressure than atmospheric pressure to said extrusion means to introduce said supercritical fluid into said molten material so that said molten material is substantially saturated with said supercritical fluid, said saturated molten material being supplied from said extrusion means to said die means to produce a shaped continuous material;

means for engaging and transporting said shaped continuous material through a first enclosed volume having a controllable pressure which is lower than said higher pressure to produce cell nucleation in said shaped continuous material and means for maintaining the temperature of said shaped continuous material at a selected temperature to maintain said cell nucleation as said shaped continuous material is transported through said first enclosed volume at said lower pressure; and

means for engaging said shaped continuous material as it exits from said first enclosed volume and for transporting said exiting material into a second enclosed volume having a pressure lower than said

controllable pressure so as to produce a shaped continuous foamed material having a plurality of cells distributed substantially throughout said shaped continuous foamed material.

21. A system in accordance with claim 20 wherein said die means is a sheet die means for providing a continuous sheet of material.

22. A system in accordance with claim 20 wherein the pressure in said second enclosed volume is at atmospheric pressure.

23. A system in accordance with claim 20 and further including means for controlling the residence times of said shaped continuous material in said first and second enclosed volumes.

24. A system for producing a foamed material comprising

a barrel;

a screw member mounted for rotation within the barrel and having a plurality of irregular blades positioned on said screw member;

means for introducing a material to be foamed into said barrel for movement along said barrel toward said irregular blades by said screw member;

means for heating said barrel to place said material into a molten state;

means for introducing a supercritical fluid into said barrel at said irregular blades at a temperature and pressure above the critical temperature and pressure of said supercritical fluid for mixing said fluid with said molten material to provide a mixture thereof;

a static mixer for receiving said mixture and for changing the orientations of the interfaces between said material and said supercritical fluid in the mixture;

a diffusion chamber for receiving said mixture from said static mixer to diffuse the supercritical fluid into the material to be foamed, said static mixture and diffusion chamber providing to provide a solution of said material substantially saturated with said fluid and having a substantially uniform concentration of fluid throughout said solution;

means for rapidly heating said solution to provide a plurality of nucleated cells in said solution at a pressure which prevents expansion of said cells in the solution;

means for receiving said solution from said diffusion chamber and for expanding the cells in said solution to provide a foamed material.

25. A system in accordance with claim 24 wherein said receiving means includes

a mold for receiving said solution from said diffusion chamber and having a counter pressure for initially preventing expansion of said cells in the solution; and

means for subsequently rapidly reducing the counter pressure in said mold to expand the cells in said solution to provide a molded foamed article in said mold.

26. A system for producing foamed material comprising:

an extruder having an inlet for receiving a precursor of a foamed material at an inlet end thereof, an outlet at an outlet end thereof for releasing foamed material from the extruder, and an enclosed

passageway connecting the inlet with the outlet constructed and arranged to contain a supercritical fluid admixed with molten material to be foamed within the passageway and to maintain the supercritical fluid in a supercritical state therein;

a nucleator associated with the passageway capable of nucleating the supercritical fluid admixed with the molten material in the passageway in the absence of an auxiliary nucleating agent; and

an orifice between the inlet and the outlet, fluidly connectable to a source of supercritical fluid or supercritical fluid precursor arranged such that supercritical fluid, admixed with molten material in the extruder, can be maintained in a supercritical state in the extruder.

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